Physiological healing patterns: What clinicians need to know about tooth extractions

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After a tooth has been extracted, a series of processes are set in motion that ultimately results in the healing of the alveolus. As demonstrated in animal studies and human studies, extra-alveolus healing usually starts with the formation of a coagulum in the alveolus immediately after the tooth has been extracted. This clot is then progressively replaced by a provisional matrix, which functions as a scaffold for the woven bone that will form from the lateral walls and the bottom of the alveolus to fill the extraction socket eventually. Subsequently, the immature bone becomes mature alveolar bone.

In this time, extra-alveolus processes continue. Extra-alveolus healing occurs concomitantly and will result in vertical and horizontal resorption of the walls of the extraction socket, a process that is more pronounced at the buccal than at the lingual aspects.

A recent systematic review on post-extraction alveolar dimensional changes in hard and soft tissue in humans reported a horizontal dimensional loss of 28–63% and a vertical dimensional loss of 15–32% six months after tooth extraction. Moreover, it reported that the reduction of alveolar crest dimensions was faster during the first six months of healing and continued after that. In a clinical study, the width of the alveolar crest at the buccal and lingual aspects was measured in edentulous sites and compared with the dentate contralateral sites in 149 cast models. A reduction of the alveolar crest of about 3.5 to 3.6 mm at the buccal aspect and 1.7 to 2.0 mm at the lingual aspect was observed. Another study found a total reduction of the width of the alveolar crest of about 30% after 3 months and of 50% after 12 months.

When an implant is placed immediately into the extraction socket, the physiological healing patterns of the alveolus are different from those described above. In order to better understand these processes, it is important to mention two processes that have been proposed as explanations for osteointegration, namely distance and contact osteogenesis.

In order to study this supposition, a series of experiments on animals were conducted. Recipient implant sites were prepared in the alveolar crest according to the usual protocol. The marginal 5 mm of the sites was subsequently widened with a drill so that a marginal gap of 5 mm in depth and 1.25 mm in width was obtained between the rough surface implant and the bony walls after implant placement. All of the experimental sites were covered with collagen membranes.

The fully submerged and histological outcomes were evaluated after one, two and four months. It was observed that the defects had filled with newly formed bone after one month (Fig. 2). However, the bone was separated from the implant surface by a 0.4 mm-wide layer of connective tissue, similar to that described in the previously mentioned study. Only in the apical 1.8 mm of the defects was new bone integrated on to the implant surface, leaving the coronal 3.2 mm occupied by connective tissue attached to the implant surface.

After two months, 1 mm more was gained coronally, leaving a remaining defect of 1.9 mm. After four months, bone healing was finally complete (Fig. 2).

Similar patterns of healing have been described for implants placed immediately into extraction sockets, demonstrating again that bone formation originated from the lateral bony walls, rapidly filling the defect. Osteointegration on the surface, however, started apically within the defect from the site of contact between the implant and the native bone, and took a longer time to complete with the physiological healing of an extraction socket (one month).

Another important factor to be considered is osteoconduction, which can be defined as the process during which bone grows on to a surface. It is a well-established that moderately rough surfaces provide higher osteoconductivity and induce a higher degree of osteointegration compared with turned surfaces. While this difference in osteoconductivity may have limited clinical significance, more attention should be paid to marginal defects present at implant placement. In fact, experimental studies have demonstrated incomplete healing of marginal defects with implants with turned surfaces. This may be related to the lower osteoconductive potential and capacity of turned surfaces to maintain this property over time compared with rough surfaces. This may be relevant when implants with a turned surface are placed into extraction sockets or placed at the same surgical stage of sinus floor elevation, for example.